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THE QUESTIONABLE PREVAILING MEAT INSPECTION REGULATIONS FOR
PREVENTION OF TUBERCULOSIS AND BRUCELLOSIS

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- East Germany -

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FOREWORD

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THE QUESTIONABLE PREVAILING MEAT INSPECTION REGULATIONS FOR
PREVENTION OF TUBERCULOSIS AND BRUCELLOSIS

- East Germany -

[Following is the translation of an article by G. Seidel in
Das Deutsche Gesundheitswesen (The German Public Health Service),
Vol XV, No 49/50, East Berlin, 1960, pages 2387-2403.]

Newman writes: the very objective of medicine is the prevention of disease, and the necessity for therapy is a tacit acknowledgement of its failure. Still, since time immemorial preventive medicine has exercised its influence upon the behavior of the individual and of the community, rather than being a mere tool of medicine.

The prevention of diseases is the goal of preventive medicine, to which veterinary medicine renders a valuable contribution. An important part of our contribution to preventive medicine lies in the field of meat hygiene. Since today tuberculosis and brucellosis are prominent diseases in animals and in human beings as well, we have decided to investigate whether the prevailing legal regulations for the inspection of meat and slaughter animals are satisfactory in the light of present scientific knowledge regarding the prevention of these two epidemics. If this should prove not to be the case we shall propose changes. The prevailing measures for the control of brucellosis and tuberculosis in animals, and the changes suggested in the latest literature will be taken into consideration. (In the Federal Republic a partially new version of Section A of the directions for the effectuation of meat inspection laws has been in force since August 1, 1960; this will be discussed in detail later on.)

Table 1 shows the results obtained in 1959 in the testing for tuberculosis of individual milk samples sent to the veterinary inspection office and veterinary health office of Greater Berlin.

On the basis of the results of pathological and anatomical investigations carried out by Nieberle, which were published in 1938 in the book Tuberkulose und Fleischhygiene [Tuberculosis and Meat Sanitation], on which the regulation for meat inspection published in 1940 are based, Schonberg has prepared the following detailed table (Table 2) which appeared in the fifth edition of his book Die Ausfuehrung der tierärztlichen Fleischuntersuchung [Procedures in the Veterinary Inspection of Meat ...] (1958).

As shown in the tables, it was assumed that in the primary infection and in chronic organic tuberculosis no tubercle bacilli are present in

the flesh. Acute hematogenous miliar tuberculosis proved to be especially dangerous; here Meyn found TB - bacilli in 85% of the cases.

The question is whether over the past 20 years the principles laid down by Nieberle are still valid, and whether the requirements of meat sanitation and of preventive medicine have been fulfilled to the effect that no infected meat is passed for food.

Meyn (1955) also thoroughly investigated the results and problems of tuberculosis research in veterinary medicine. He indicates that the intensive research work done by veterinarians with regard to tuberculosis, especially before World War II, has led to results which have extraordinary scientific and practical importance; but, on the other hand, a great many new problems have arisen. In his work he discusses mainly these two points:

- a) the relation between tuberculosis research and meat sanitation;
- b) the relation between tuberculosis research and the prevention of T. B.

Table 1

Individual milk samples sent in to be tested for tuberculosis in 1959

Number of samples sent in	911
Of these examined serologically (KBR) [Komplement-bindungsreaktion - complement fixation test]	911
Positive reactors or suspected of being infected	46
Number of live animal tests	119
Positive reactors out of these	11

The regulations for passing with regard to tuberculosis are discussed in the following:

Form of tuberculosis	Prevailing rules for passing in meat inspection
1. Primary infection	Parts showing abnormalities 7/34.4 condemned
2. Chronic TB of the organs	Parts showing abnormalities 7/34.4 condemned
3. Generalized TB without evidence of acute hematogenous miliar TB	a) Parts showing abnormalities 7/34.4 passed b) Inspection of the so-called lymph glands in the flesh 7/21.12

4. Generalized TB with evidence of acute hematogenous miliar TB (fresh blood infection)

c) If one or more lymph glands in the flesh are affected by TB, the respective medullated bones are to be removed and to be split lengthwise (¶ 34.4)

d) If bones are affected by TB the skeleton is to be condemned (flesh of the muscles ¶ 34.4)

a) In suspected cases the kidneys are to be removed from the carcass for detailed inspection.

b) Parts showing abnormalities condemned

c) Entire carcass passed with reservations (¶ 36.I)

The first of the two above-mentioned points merits closer investigation. Nieberle's research results confirm the assumption that from the results of meat testing performed during slaughtering, valid conclusions may be drawn as to the sanitary and bacteriological condition of the meat. He uses the term "acute hematogenous miliar tuberculosis" to cover three forms of TB in cattle, which are distinct as to their pathogenetic qualities and manifestations; these are:

- A. Acute miliar tuberculosis, early generalization, which originates immediately adjacent to the primary lesion,
- B. Acute miliar tuberculosis, late generalization, which originates from tuberculous lesions which are not arrested,
- C. Caseous tuberculosis of the organs in the break-down stage.

The regular occurrence of tubercle bacilli in the muscles in these generalized forms of tuberculosis has confirmed the results of bacteriological research carried out by Nieberle and various other authors.

The following forms of bovine tuberculosis are considered to be localized (as contrasted to generalized) by Nieberle:

- 1. Primary infection
- 2. Certain latent forms of early generalization which he calls "chronic or protracted generalization".

Table 2

Form of tuberculosis	Special characteristics	Regulations for Passing
1. Primary infection a) in the lungs	Individual isolated nodules of varying size, especially under the pleura, the size varying from a hazelnut to a fist, caseous or calcified, distinctly delineated from adjacent region by connective tissue. Lymph glands in the area have coagulated and calcified centers.*)*)If tuberculosis is found in the lymph glands of the lungs, the parenchyma must be thoroughly investigated, with several cuts and examination of both lungs.	Affected organ condemned according to Par. 34, No 4 of AB.A (section A of directions for effectuation of the meat inspection laws).
b) in the digestive tract	Often tuberculosis of the lymphatic larynx and tonsils. Disintegrating lesions of a dauby appearance, tonsils considerably enlarged. In the intestinal mucous membrane smaller or larger abscessed lesions, intestinal lymph glands considerably enlarged and caseous.	Affected organ condemned according to Par. 34, No. 4, AB.A.

- | | | |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| c) Congenital tuberculosis (primary lesion in the liver) | Usually congenital tuberculosis in calves, portal lymph gland shows considerable tubercular abnormalities, tubercles coagulate from the center, or diffuse dry coagulation, or radiant coagulation. | Affected organ condemned acc. to Par. 34 No. 4 of the AB.A. |
| 2. Early generalization (chronic, protracted tuberculosis of organs, especially of the lungs) | Coagulated or calcified tuberculous lesions in organs and lymph glands connected thereto. Considerable enlargement of lymph glands with many small coagulated lesions. No general manifestations, especially no hyperemia. | Affected organ condemned acc. to Par. 34 No. 4 of the AB.A. |
| 3. Chronic tuberculosis of the organs, especially chronic lung tuberculosis in cattle (isolated) | Azinous and azinous-nodous lesions, caverns, tubercular abscesses in the bronchial tubes and trachea. No tubercles in the lymph glands. Sometimes lymph glands show raised swelling. No calcification in tuberculous lesions, no delineation by connective tissue. | Affected organ condemned acc. to Par. 34 No. 4 of the AB.A. |
| Chronic tuberculosis of the udder (isolated) | Widespread dry coagulation, cracked, sometimes with coagulated galactophoritis, lymph glands in the area remain unaffected, tough consistency of the tuberculous regions. | |
| 4. Acute hematogenous miliar tuberculosis (early generalization) | Usually considerable emphysema in the lungs, many very small lesions of miliar and submiliar size of glassy transparency. Also larger lesions of irregular shape. Also often radiant coagulation in the connected lymph glands, miliar lesions in the kidneys and often in the liver. | Carcass passed with reservations, affected parts condemned, Par. 36 of the AB.A. |

5. Acute hematogenous miliar tuberculosis of the reinfection period [Translator's note: German text has Reininfektionsperiode. must be error?]. Considerably enlarged lung is emphysematous, hangs heavily on the hook and seems voluminous. Lung parenchyma heavily invaded by miliar round tubercles, partially transparent, partially opaque. Lymph glands often completely normal. In kidneys often moderate number of miliar tubercles! In liver miliar tubercles histologically determined. Carcass passed with reservations, affected parts condemned, Par. 36 of the AB.A.
6. So-called breakdown forms
a) fresh pneumonia with coagulating lesions (Pneumonia caseosa) Irregular coagulating pneumonic lesions of greatly varying size in the lung which show an opaque dry light-yellow mass shot through with small blood spots. Lymph glands connected thereto considerably enlarged, show perifocal edema, are characterized by fresh inflammatory infiltrations on freshly cut surfaces, strong hyperemia or radiant coagulation, also dry coagulation with fine blood spots in the lymph glands. Carcass passed with restrictions, affected parts condemned. Par. 36, AB.A.

b) galloping azinous pulmonary tuberculosis

Many small azinous tuberculous lesions with soft pus-like centers. Lungs enlarged by emphysems and very light colored. Tuberculous cut surface often shows perifocal discoloration with a bluish-red tinge. Pulmonary lymph glands often also affected with manifestations of fresh infiltrating coagulation, lymphadenitis caseosa (dry coagulation with blood spots).

Carcass passed with restrictions, affected parts condemned. Par. 36 AB.A.

c) Inflammation with diffuse coagulation of serous membranes, udder, uterus, and kidneys

Large surface dry-caseous lesions with blood spots, enlarged lymph glands connected to organs also affected (radiant coagulation with blood spots in lymph glands).

Carcass passed with restrictions, affected parts condemned. Par. 36 AB.A.

With complete emaciation the entire carcass is to be condemned (Par. 32 (I) 17 AB.A)

3. Isolated tuberculosis of organs.

His statement that in these forms no tubercle bacilli can be determined in the flesh by culture tests was refuted by bacteriological investigations and pathogenetic considerations. These considerations also confirm the test results of many other authors. There is no doubt that even in localized forms of tuberculosis, tubercle bacilli may be isolated from the muscles.

Re 1.: The primary lesion is the first reaction of the body to the invasion of tubercle bacilli. In this phase, the tuberculous process may be checked, repaired or healed, but it may also progress and generalize. The invasion of tubercular bacilli in the blood directly or via the lymphatic system from the primary lesion is therefore quite possible. According to Nieberle, antibodies can "at least temporarily" check the further progress of the infection. Whether an infection of the blood originating in one particular primary lesion does develop, and under what circumstances, has not yet been determined. The fact that this does occur has been confirmed by numerous tests performed by the author (Meyn). Of 132 heads of cattle in which only a complete or incomplete primary lesion was found during meat inspection, virulent tubercular bacilli were found in the muscles in 6 cases (= 4.5%).

Re 2.: "Chronic or protracted generalization" of tuberculosis in cattle appears mainly in latent forms of early generalization according to Cohrs' nomenclature; it occurs when the tuberculosis has transcended the primary lesions, that is, it has generalized, but is "no longer in the acute stage". The tubercle bacilli penetrating from the primary lesion into the blood are quickly localized in the muscles for the purpose of defense. Often coagulated and calcified lesions of tuberculosis of varying size form in the organs, in cattle mainly in the serous tissue.

Meyn's tests proved that in 21 of 122 cases (=17.2%), the flesh was harboring tubercle bacilli.

Re 3.: Isolated tuberculosis of the organs is considered a post-primary process and appears only when a new infection of exogenous or endogenous character is spreading from arrested lesions remaining from the primary infection. Cohrs calls the early reinfection period the "period of post primary processes". This definition affords a considerably clearer grasp of tuberculous processes.

Usually isolated tuberculosis of the organs develops hematogenically (chronic udder- and testicle tuberculosis as well as isolated pulmonary tuberculosis). An invasion of tubercle bacilli into the blood, which usually precedes these forms of tuberculosis, leads to deposits of bacilli in the muscles. If the body has enough antibodies, the tubercle bacilli remain latent in the tissues until they have been destroyed by phagocytosis. Therefore we must expect the presence of tubercle bacilli in the muscles in this form of tuberculosis also. In tests performed by the author (30 of 244 heads of cattle with isolated tuberculosis of the organs = 12.3%), tubercle bacteria were found in the flesh and thus the correctness of the above suppositions was confirmed.

The statement by Nieberle that the flesh of cattle affected by so-called localized forms of tuberculosis is free from tubercles thus cannot be accepted without reservations. Nieberle clearly leaves open the possibility of a temporary invasion of the blood by tubercle bacilli and the resulting deposits of germs in the tissues in these forms of tuberculosis; his work Tuberkulose und Fleischhygiene [Tuberculosis and Meat Sanitation] explains this. We quote verbatim:

"We know from recent pathogenetic investigations that we must always assume an occasional circulation of tubercle bacilli in the blood in any form of comparatively advanced tuberculosis, and moreover, without assuming such an occasional occurrence of tubercle bacilli in the blood, the pathogenesis of a chronic tuberculosis of the organs cannot be explained at all." Nieberle's research results are still the firm, reliable foundation for any later development and expansion with which we are concerned today. Only his opinion that only a few germs participate in the occasional invasion of tubercle bacilli in the blood, and that the virulence of these germs is considerably weakened by an increased resistance of the body, does not hold true. Regulations for passing on the carcasses of animals thus affected cannot be derived from

this concept. From the above considerations, Meyn arrives at the following questions: Is the occurrence of tubercle bacilli in the muscles in localized forms of tuberculosis so insignificant that it can be neglected in meat inspection? According to his opinion this question can no longer be answered in the affirmative without reservations when considering recent advances in research. The occurrence of fully virulent tubercle bacteria in the flesh has been proved even for cases of localized tuberculosis, so that there can no longer be any doubt as to the danger of infection for human beings. No law governing the difference in virulence of the different forms of tuberculosis could be derived from testing cultures obtained from the flesh.

Meyn then investigated the quantitative occurrence of tubercle bacilli in the muscles of cattle infected with tuberculosis in order to obtain a satisfactory solution for the problem. He performed tests on cultures as well as on live animals. In cultures, the samples from the flesh of cattle affected with isolated tuberculosis of an organ, or tuberculosis of several organs were not essentially different from samples taken from cattle with acute hematogenous miliar tuberculosis; for the germ content in the flesh no set limiting value could be determined for either form of tuberculosis. The determination of tubercular bacilli in samples taken from positive reactors was possible only in live animal tests, never from cultures. Meyn tried, within certain limits, to draw conclusions as to the germ content from the percentage of affected animals out of a total of infected guinea pigs. He published the following table:

Primary lesions	15% of infected guinea pigs
Isolated chronic tuberculosis of organs	32% of infected guinea pigs
Tuberculosis of several organs, that is, chronic generaliza- tion according to Nieberle	45% of infected guinea pigs
Acute generalized forms	56% of infected guinea pigs

Contrary to the results from culture tests, these results confirm that tubercle bacilli are probably found more often in the flesh of cattle affected by tuberculosis in several organs than in cattle with chronic tuberculosis of an isolated organ.

According to Meyn, it is not the bacteriologist alone who is responsible for passing on the disposal of flesh from tuberculous cattle, but in addition to sanitary considerations, there are important economic considerations.

In 1954, Cohrs and Obiger published the following results of their tests: (See Table 3, following page)

Table 3.
Presence of tubercle bacilli in the flesh of tuberculous
slaughter animals.

	Number of animals	Number harbor- ing TB bacilli in muscles	$\%$
<u>Group I</u> Complete or incomplete primary infection	53	4	7.5
<u>Group II</u> Early generalization latent, inactive lesions	5	1	20
<u>Group III</u> Isolated tuberculosis of organs	34	6	17.5
<u>Group IV</u> Combination of II and III	8	1	12.5
<u>Total</u>	100	12	12

Other authors have confirmed these results. Thus Meyn and Schliesser obtained the following results in 1957 (see tables 4-6).

Thus it has been proved beyond doubt that even in localized forms of tuberculosis, a considerable number of tubercle bacilli may be found in the flesh, and that the danger of infection exists for these forms as well. The amount of tubercular bacteria found in the flesh and that found in the fresh infection of the blood differs considerably. However, when there were only primary lesions, few tubercle bacilli were found in the flesh.

The germ content of tubercle bacilli was highest in acute hematogenous miliar tuberculosis, and it decreased in the following order:

Chronic tuberculosis of several organs and chronic forms of generalization, isolated chronic lung tuberculosis and primary infection. The virulence of the germs did not differ much. The slow progress of the disease in the primary complex is attributed by Meyn and Schliesser to the lower germ content.

Piening, in his publication concerning problems of passing on tuberculous lymph glands of cattle and swine during meat inspection arrives at the following conclusions:

Table 4.
Occurrence of tubercle bacilli in the flesh of tuberculous
cattle.

Form of tuberculosis		Number of samples examined	Tubercle bacilli found in flesh in
Localized tuber- culosis in terms of AB.A of meat inspection regula- tions	Primary infection	132	4.5% of cases
	Isolated chronic pulmonary tubercu- losis	304	13.1% of cases
	Chronic TB of several organs and charon. generalized forms according to Nieberle	212	18.4% of cases
Total		648	13.1% of cases
Acute hematogenous miliar tuberculosis		52	61.5% of cases

Table 5.

Survey of content of tubercle bacilli in flesh of tuberculous cattle.

Form of tuberculosis	Culture tests positive	Average No. of colonies grown	Positive reactors diseased
Primary infection	-	-	15.4% of animals tested
Isolated chronic pulmonary tuberculosis	2.3%	2.1	35.7% of animals tested
Chronic tuberculosis of several organs and chron. generalized forms	7.5%	5.2	47.6% of animals tested
Acute hematogenous miliar tuberculosis	26.9%	6.0	57.1% of animals tested

Table 6.

Virulence of tubercle bacilli occurring in test animals

Form of tuberculosis	Average No. of deaths from generalized TB up to 8th week after infection	Average distribution of TB in body of tested animals
Primary infection	-%	+++(+)
Isolated chronic pulmonary tuberculosis	22.2% of animals tested	+++
Chronic TB of several organs and chronic generalized forms	25.2% of animals tested	+++(+)

Legend:

- +++ Tuberculosis of lymph glands in affected area, of spleen, liver, or lungs.
- +++ (+) Tuberculosis of lymph glands in affected area, of spleen, liver, or lungs [sic!]

1. The abnormalities in the lymph glands ascribed to tuberculosis during the veterinary inspection of slaughter cattle and swine proved to be non-tuberculous in 17.5% of the cattle and 70% of the swine.

2. Even when a lesion which seemed calcified in macroscopic examination was found in only one lymph gland, live animal tests of cattle proved that in 18.56% of the meat samples tested, virulent tubercular bacilli were still present in the muscles.

3. With any form of tuberculosis in the lymph glands we must anticipate the occurrence of bacilli in the blood.

4. We propose in doubtful cases to examine the suspected lymph gland histologically; this can be done just as quickly as a bacteriological examination of the flesh.

The prevailing regulations thus no longer correspond to the requirements either of meat sanitation or preventive medicine. The changed situation is taken into account, among others, by Henneberg (Vienna 1959) in his proposal regarding the inspection of the meat of tuberculous slaughter animals. He, as so many others before him, is trying to achieve a compromise between economic and sanitary requirements, and he proposes the following directions for Austria (Table 7):
(See following page)

Table 7.

State of health and abnormalities

Directions for passing

a) Any part or organ showing tuberculous abnormalities (an organ is to be considered tuberculous even when only the lymph gland connected thereto shows tuberculous abnormalities.)	Condemned
b) High degree of emaciation	All flesh condemned
c) Primary infection, complete or incomplete, without inflammable hyperemia in the primary lesion or lymph gland	Organs showing abnormalities condemned, otherwise passed.
d) Primary infection having spread to an organ in stage of early generalization with only scattered lesions (protracted generalization) without evidence of acute inflammable processes and with unaffected serosa.	Organs showing abnormalities condemned, otherwise passed
e) In all cases of 1. Miliar tuberculosis, also general tuberculosis with large lesions in calves and young cattle (fresh multiple pneumonia with lobular coagulation)	Organs showing abnormalities condemned, flesh passed with restrictions
2. Break-down forms f) Chronic tuberculosis of lungs and serosa g) Isolated chronic pulmonary tuberculosis with bronchoectatic caverns h) Distribution of tuberculous abnormalities in two or more organs	Organs or parts showing tuberculous abnormalities (parietal blade of the serosa with attached tissues, also bones of the sternum) condemned; other flesh passed as inferior *) **)
i) Bone tuberculosis	Entire skeleton condemned.
j) In all cases	Flesh passed as inferior *) **) Flesh passed **)

*) With the stipulation that in the meat market a clearly legible sign requires the customer to eat this meat only well cooked or fried.

**) Unless stricter regulation obtain because of other factors determined during inspection (this for all forms of tuberculosis). After official notification that tuberculosis in cattle has been eradicated in Austria, all previous regulations concerning meat inspection in regard to tuberculous cattle are no longer legally binding.

From this point on the flesh of all slaughter animals found to be affected with tuberculosis is to be passed with restrictions unless it must be condemned on the basis of facts brought to light during inspection. Parts and organs showing tuberculous abnormalities are to be condemned.

Concerning points c) and d), Henneberg writes:

Concerning c), If in primary infection no inflammable hyperemia is found in either the primary lesion or the lymph gland in the affected area, bacilli may still be present in the blood, but the possibility is much more remote and there is probably no great danger since primary infection without further distribution usually occurs only in a well-nourished young animal whose meat will be eaten only cooked or fried.

Concerning d), the same can be said of chronic, or protracted generalization.

Furthermore, the fact is stressed that restrictions in the passing on meat are only meant to apply while the fight for the eradication of tuberculosis is still going on. Goerttler writes in this connection, verbatim: "What doubts and uncertainties have been created with the passing of the regulations governing the inspection of tuberculous slaughter animals and the directions for their perpetration! Neither scientific advances nor constant changes in the regulations have solved these problems. It is hard to keep up with all the pertinent publications. Tomes have been written about this, but a clearly defined outline for the inspection of meat has not yet been created. Such directions should include the requirement that all animals showing evidence of more than one primary infection without manifest inflammation be either passed with restrictions or condemned.

The present complicated and contrived regulations are concessions to economic requirements; not only do they ask too much of the veterinary meat inspector, they no longer conform to the present state of our scientific knowledge. At this time, many carcasses and organs containing tubercle bacilli are still passed for food as either fully satisfactory or inferior in complete accord with the legal regulations.

In the "Regulations Governing the Meat Inspection of the United States Department of Agriculture" the following is said concerning the inspection with regard to tuberculosis:

Par. 11.2 Tuberculosis: principles for guidance in passing on carcasses affected.

The following principles are declared for guidance in passing on carcasses affected with tuberculosis:

a) No meat should be passed for food if it contains tubercle bacilli or if there is a reasonable possibility that it may contain tubercle bacilli, or if it is impregnated with toxic substances of tuberculosis or associated septic infections;

b) Meat should not be destroyed if the lesions are localized and not numerous, if there is no evidence of the distribution of tubercle bacilli through the blood or by other means to the muscles or to parts that may be eaten with the muscles, and if the animal is well nourished and in good condition, since in this case there is no proof, or even reason to suspect, that the flesh is unwholesome.

c) Evidences of generalized tuberculosis are to be sought in such distribution and number of tuberculous lesions as can be explained only by the supposition of the entrance of tubercle bacilli in considerable number into the systemic circulation. Significant of such generalization is the presence of numerous uniformly distributed tubercles throughout both lungs, also tubercles in the spleen, kidneys, bones, joints, and sexual glands, and in the lymph glands connected with these organs and parts, or in the splenic, renal, precapsular, popliteal and inguinal glands, when several of these organs and parts are coincidentally affected.

d) Localized tuberculosis is tuberculosis limited to a single or several parts or organs of the body without evidence of recent invasion of numerous bacilli into the systematic circulation.

Par. 11.3 Disposition when affected with tuberculosis.

Carcasses of animals affected with tuberculosis shall be disposed of as follows:

a) The entire carcass shall be condemned if any of the following conditions occur:

1. When it was observed before the animal was killed that it was suffering with fever;

2. When there is a tuberculosis or other cachexia;

3. When the lesions of tuberculosis are generalized, as shown by their presence not only at usual seats of primary infection, but also in parts of the carcass or in the organs that may be reached by the bacilli of tuberculosis only when they are carried in the systemic circulation.

Tuberculous lesions in any two of the following mentioned organs are to be accepted as evidence of generalization when they occur in addition to local tuberculous lesions in the digestive or respiratory tracts, including the lymph glands connected therewith, spleen, kidney, uterus, udder, ovary, testicle, adrenal gland, and brain or spinal cord or their membranes. Numerous tubercles uniformly distributed throughout both lungs also afford evidence of generalization.

4. When the lesions of tuberculosis are found in the muscles or intermuscular tissue or bones, or joints, or in the body lymph glands as a result of draining the muscles, bones, or joints;

5. When the lesions are extensive in one or both body cavities;

6. When the lesions are multiple, acute and actively progressive.

Evidence of active progression consists of signs of acute inflammation about the lesions, of liquefaction necrosis, or the presence of young tubercles;

b) An organ or part of a carcass shall be condemned under any of the following conditions:

1. When it contains lesions of tuberculosis.
2. When the lesion is localized but immediately adjacent to the flesh as in the case of tuberculosis of the parietal pleura or peritoneum. In this case not only the membrane or part affected but also the adjacent thoracic or abdominal wall is to be condemned.
3. When it has been contaminated by tuberculous material (through contact with the floor or a soiled knife or otherwise).
4. Heads showing lesions of tuberculosis shall be condemned, except that a head is from a carcass [passed for food or for cooking], and the lesions are slight or calcified or capsulated and confined to lymph glands in which not more than two glands are involved; the head may be passed for cooking after the diseased tissues have been removed and condemned.
5. An organ shall be condemned when the corresponding lymph gland is tuberculous.
6. Intestines and mesenteries showing lesions of tuberculosis shall be condemned except when the lesions are slight and confined to the lymph glands and the carcass is passed without restriction. The intestines may be passed for use as casings and the fat passed for rendering after the corresponding lymph glands have been removed and condemned: provided that the fat and intestines have not been contaminated with tuberculous material.

c) Carcasses showing lesions of tuberculosis shall be passed for food when the lesions are slight and localized, calcified or capsulated, or are limited to a single or several parts or organs of the body (except as noted in paragraph (a) of this section) and there is no evidence of recent invasion of tubercle bacilli into the systemic circulation. Under this paragraph, carcasses showing such lesions as the following examples may be passed after the parts containing the lesions are removed and condemned in accordance with paragraph (b) of this section:

1. In the cervical lymph glands and two groups of visceral lymph glands in a single body cavity, such as the cervical, bronchial, or mediastinal glands, or the cervical, hepatic, and mesenteric glands;
2. In the cervical lymph glands and one group of visceral lymph glands and an organ in a single body cavity, such as the cervical or bronchial glands and an organ in a single body cavity [sic!], or the cervical and hepatic glands and the liver;
3. In two groups of visceral lymph glands in the thoracic cavity and one group in the abdominal cavity or in one group of visceral lymph glands in the thoracic cavity and two groups in the abdominal cavity, such as bronchial, mediastinal and hepatic lymph glands, or, bronchial, hepatic and mediastinal lymph glands;

4. In two groups of visceral lymph glands in the thoracic cavity and one group in the abdominal cavity, such as bronchial, mediastinal and hepatic lymph glands, or, bronchial, hepatic, and mesenteric lymph glands;

5. In the cervical lymph gland and one group of visceral lymph glands in each body cavity, such as cervical, bronchial and hepatic lymph glands;

6. In the cervical lymph glands and one group of visceral lymph glands in each body cavity together with the liver when the latter contains but few localized foci.

In this class of carcasses, which will be chiefly those of hogs, the lesions of the liver are considered to be primary, as the disease is practically always of alimentary origin;

d) Carcasses which reveal lesions more severe and more numerous than those described and passed according to paragraph c of this section, but not so severe nor so numerous as the lesions described from carcasses to be condemned (paragraph a of this section) may be rendered into lard, pork fat, or tallow, or otherwise cooked in accordance with part 15 of this subchapter if the distribution of the lesions is such that all parts containing tuberculous lesions can be removed.

In the regulations governing the veterinary sanitation inspection of slaughter animals and of meat and meat products in the Soviet Union, the following is said in regard to tuberculosis:

25. Tuberculosis.

A. In the case of any form of infection of organs and lymph glands combined with emaciation, or in the case of generalized processes, the carcass and organs are passed for industrial use.

B. In the presence of tuberculous infections in an organ or the lymph gland without concurrent emaciation, the carcass is assigned to disinfection after removal of the infected organs according to paragraph 134a), and the bacon and intestinal fat are to be passed for rendering according to paragraph 134b) of these regulations. The organs affected by tuberculosis are passed for industrial processing regardless of the form of infection.

C. If tuberculous abnormalities are found in the bones, the entire carcass is passed for industrial processing, the muscular tissue is disinfected according to paragraph 134a) of these regulations.

D. The hides of tuberculous animals are passed without disinfection.

Note: The veterinary-sanitary inspection of carcasses and organs of birds and rabbits is governed by Sections IV and V of these regulations.

Barnitzki writes in this connection that a grade of "pass" or "pass with restrictions" may be given as justified by the extent of the abnormalities. For reasons of national economy, carcasses showing only a primary infection should be passed. A successful campaign of tuberculosis control will justify more stringent measures later on. Since in

the Federal Republic the occurrence of tuberculosis in cattle has reached a very low point, the following changes were effected in the directions for the effectuation of meat inspection laws, Section A, with regard to tuberculosis, published 1 August 1960, paragraph 1 reads as follows:

Paragraph 21.13: When generalized tuberculosis is found in the lymph glands of shoulder clod, shoulder, sternum, neck, knee bend and knee folds, ischium, median and lateral ilium, loins, lower and upper thoracic wall including the cartilage of the fossa, and of the abdominal and pelvic cavities; the glands are to be removed and cut into thin slices unless they are needed for bacteriological tests; if tuberculosis is found in the lymph glands, the corresponding medullated bones in the flesh are to be removed and to be split lengthwise; brain and spinal cord are to be sampled and tested.

Paragraph 34 b): No. 4 reads as follows:

4. Tuberculosis

Organs are considered to be tuberculous even if only the corresponding lymph glands show tuberculous abnormalities; if tuberculosis is found in the mesenteric lymph gland, the intestine (small and large), including the intestinal fat, is to be considered tuberculous; in pulmonary tuberculosis or a corresponding tuberculous lymph gland, trachea and larynx are considered tuberculous also. If there is tuberculosis in the bones, all bones are considered tuberculous.

Paragraph 36, No. II, Fig. 1 & 2 reads as follows:

The slaughtered animal is passed with restriction except for parts condemned under paragraph 34 if one of the following abnormalities has been determined:

1. Tuberculosis
2. Erysipelas in swine, except when paragraph 32, par. 1 No. 9 applies, and brucellosis in swine.

Since we are not in the enviable position of the USSR, where only 0.1% of the tuberculin reactions are positive (Boiko as of 1 January 1957), we have as early as 1957 proposed a sliding scale for meat inspection with regard to bovine tuberculosis which takes into consideration the respective state of tuberculosis control. We still consider this proposal valid, and therefore we quote verbatim:

"At what degree of freedom from tuberculosis the steps mentioned below should be activated by the regulatory authorities would have to be decided after conferring with a committee for tuberculosis control yet to be created.

Another condition to be met before the authority enacts the next step is that all officials concerned be informed and instructed as to the resulting consequences. The new regulations and directions for their effectuation would have to be presented in special courses to veterinary meat inspectors.

As a first step in the sliding scale for meat inspection, the personnel concerned must be made aware of the fact that control of tuberculosis and inspection of meat must go hand in hand in order to guarantee complete success.

The following steps are proposed:

1. Retain the present legal regulations under strict interpretation of the respective paragraphs and utilization of the latest scientific advances within the framework of these regulations with special consideration of the following passage from Paragraph 36 II/1 of the AB.A.. or special forms of tuberculosis where tubercle bacilli are usually found in the flesh...

2. No passing of animals affected by any tuberculous process according to paragraph 47 (inferior).

If evidence found on the carcass would indicate the application of paragraph 47, the carcass is to be condemned. All carcasses passed for food according to the prevailing regulations should be canned (passed for industrial use). Whether carcasses should be passed without the restriction of mandatory canning when only one primary infection is present will have to be discussed separately.

3. All forms of tuberculosis where considering the general state of the carcass even by the strictest standards condemnation is not indicated, pass with restrictions.

After tuberculosis has been eradicated completely:

4. All animals reacting positively to the tuberculin test or showing evidence of any form of tuberculosis are to be condemned.

In closing, we would like to emphasize that a sliding scale for meat inspection is to be considered as an exceptional measure only, which can be justified only in the light of successful tuberculosis control. To apply such a scale to other areas of meat inspection would be dangerous and would promote difficulties in interpreting the law."

Summarizing, we can say that the present regulations for the inspection of meat with regard to tuberculosis do not correspond to the requirements of meat hygiene and preventive medicine. Many proposals have been made for a change in these regulations, so that it is now the task of the lawmakers to utilize these proposals to meet the just requirements of preventive medicine.

Let us now consider the other important epidemic, that is, brucellosis, with regard to its coverage in the meat inspection regulations. We do not find brucellosis mentioned at all! The reason is that around 1940 brucellosis was not an acute problem in meat sanitation because there were few publications in the German language relating to this problem. Now we must consider the question whether this attitude is still valid after 20 years or not. If the question is answered in the negative, we shall propose directions governing the inspection of meat from slaughter animals affected with brucellosis.

Brucellosis is an epidemic which according to many experts still holds many unsolved problems concerning its occurrence in man and animal. According to Moroni, Loeffler, and Frei, Mingle in the U. S. believes that no other animal disease at present presents a greater danger to public health. The control measures developed by veterinary medicine which should be supplemented by appropriate coverage in the meat inspection laws have again brought brucellosis to the attention of the public. Since brucellosis is not included in the meat inspection regulation and its auxiliary laws, we must decide whether it should be covered by the law and if so, in what way. Since three main types can be distinguished, we shall discuss them according to the degree of danger they hold for man:

1. Melitensis infection.

In 1954, Fritzsche, Taylor, and Schoregge reported on experiences gathered during the brucellosis epidemic of sheep in Rheinland/Pfalz. *Brucella melitensis* is said to have entered from France. 179 herds with a total of 33,101 sheep (50.2% infected animals) had been infected. Since 1948, 120 human beings have been reported to have been affected through contact infection. Packing house employees refused to slaughter the animals. The sheep owners then tried to have the infected animals slaughtered illegally. Thus all doors were open for a further spreading of the disease. The authors demand that infected animals be condemned by meat inspectors.

According to Nizmansky, *brucella melitensis* has also been found in cattle, sheep, horses and wild hares in Czechoslovakia.

Larche and Entel have examined the tissues and organs of slaughter sheep suspected of being infected with brucellosis. Animals with evidence of infection or suspected of being infected on the basis of serum and allergy tests are safely destroyed in packing houses according to veterinary policy regulations.

Animals which do not react positively, i.e. those not likely to be infected, may be slaughtered without restrictions. Thus it would be possible that sheep are passed without any restrictions if carcasses and organs meet all other requirements of meat inspection regulations. Lerche and Entel have investigated the presence of *brucella* germs in animals suspected of being infected and also the possibility of a danger of infection. They found that in herds of sheep affected by the epidemic there may be carriers of *brucella* which cannot be determined by serum and allergy tests as practiced in mass inspections. Germ carriers are especially likely to be present when the herds were extensively affected by the epidemic before sanitary measures were taken, and when a large percentage of allergic animals was found besides positive reactors to serum tests. In the meat inspection of 359 sheep suspected of being infected, no evidence of disease was found except for a few parasitic abnormalities in lungs and liver. In 49 of these, which were found to be infected, the uterus contained *brucella* in 100% of the cases, the spleen in 84.4%, and the liver in 28.6%. *Brucella melitensis* in the muscles of the neck was found only once (6.2%). This distribution in the body of sheep constitutes a great danger of infection for packing house personnel. The authors reported severe cases with one fatality.

The following conclusions were drawn from the investigations:

1. The regulations of the veterinary police for the control of brucellosis in sheep and goats are not sufficiently stringent for the protection of human beings from infection, since only positive reactors to serum and allergy tests are safely destroyed.

An infected herd of sheep should be destroyed immediately in its entirety, also animals suspected of being infected, and also by-products and waste products, such as hides, wool, etc.

Entel made a thorough study of the resistance of various types of *brucella* to the different methods of meat inspection and meat processing.

He found that the melitensis type behaves differently from the others. A decrease in resistance was found only in raw sausages. Entel believes that the infection of human beings depends on the virulence of the bacillus and on the number of germs present. He, too, demands that the slaughtering of sheep suspected of being infected be prohibited.

Borger reported in 1958 that dairy cows had been infected with brucella melitensis in Schleswig-Holstein. The first occurrence of brucella melitensis in cattle was reported in 1955 by Wundt and Gehring from Southwestern Germany. In these latter cases sheep were found to have been the carriers; in the cases reported by Borger, sheep were proved not to have been the carriers of the disease. No melitensis infections in human beings were reported. Nevertheless Borger believes that for reasons of safety, cattle herds where this infection is found should be destroyed because it is practically impossible to distinguish healthy animals from those infected or from germ carriers, and because even infected animals may react negatively to serological tests.

As far as control by veterinary police is concerned, the fact that it is practically impossible to distinguish a melitensis infection from the other types because of the considerable requirements of material and time for testing, limits such control to accidental findings. Only a control of all forms of brucellosis in domestic animals would be effective. The author does not discuss meat inspection of cattle.

Seelemann reports on the advance of melitensis infection in European cattle after World War II. Melitensis infection has spread further north from the Mediterranean countries. In Great Britain, Switzerland, and the German Federal Republic infections were found especially in goats, sheep and dairy cows. Infections in dairy cattle in Great Britain and Germany did not seem to have been transmitted to human beings or other animals. Evidently the bacilli were less pathogenic, contrary to findings in other countries. Thorough biochemical, serological and biological testing proved that in Malta fever two types are present, that is, brucella melitensis and br. intermedius. These can be distinguished only by serological tests. For a more effective testing of these infections, Seelemann proposed to standardize the testing methods. He also believes that according to the present state of scientific knowledge each type of brucella may occur in any animal, also in deer and human beings, and that any type of brucellosis can be transmitted to any animal and human being if the necessary conditions for infection are prevailing.

2. Brucellosis in Swine.

In Germany brucellosis in swine has become more prominent after World War II. Thus Wagner, in 1950, Karsten, and in 1951 Meyn from Western Germany report sizable outbreaks in swine with simultaneous manifestations of brucellosis in human beings. In Mecklenburg, Becker found brucella of the suis type in 10 pregnant sows of one herd. Schroter found brucella suis in only three cases within the last 10 years in Sachsen-Anhalt.

Mahnke and Mochmann as well as Pitzschke (1957) also found brucellosis in swine in Thuringia.

Mahnke and Mochmann (1957) examined blood samples and pieces from the tissue of liver and kidneys of 1,000 slaughter hogs from the age of ten months to one and a half years. 98% of these were females. Except for two animals with severe icterus, no abnormalities were found during meat inspection. 3.5% of the animals reacted positively to serum tests. Titers up to 1:400 were found, which leads to the conclusion that the animals had once been infected. Histological examination of positive reactors did not show any evidence of a brucellosis infection. The positive agglutination titers, however, indicate the possibility of latent foci. Agglutinin against *brucella melitensis* was determined in five serums.

Heidrich (1959) reports further cases of brucellosis in swine. Of a total of 99 hogs, 66 reacted positively, and 10 of 61 females showed abnormalities caused by brucellosis. The germs could not be determined. Only in live animal tests did seven of the ten show positive titers. Germs were found only in two of the seven cases. Differentiation tests indicated *brucella suis*. The examinations further showed that uteri of hogs killed because of manifest or suspected brucellosis which did not show any evidence of disease when examined microscopically can harbor a considerable number of *brucella*. In swine showing abnormalities caused by brucellosis in the uterus, we must assume the presence of extragenital *brucella* as well. According to Heidrich, few cases of extragenital *brucella* have been reported in Germany so far. Borger reports that a few cases of brucellosis *suis* have been reported among cattle in Schleswig-Holstein.

In the Federal Republic, paragraph 276 was incorporated into the BAVG [Federal Veterinary Law] by VO [decree] of 23 June 1950 as a safeguard. According to this paragraph, flesh and waste products of brucellous swine or those suspected of being infected are to be disinfected. Disinfection is to be performed only in plants certified for this purpose and must be accomplished by boiling or steaming. These measures have been taken mainly for reasons of veterinary control. In practice, however, these swine were handled in the same way as were those passed with restrictions. King found *brucella suis* even after 30 days of cold storage at -23°C in the spleens of swine, and the same results were obtained after 40 days of pickling in brine.

Besides abortion, there were a number of other clinical symptoms, such as metritis, orchitis, arthritis, inflammation of ligaments, mastitis, paralysis of hind feet, abscesses in muscles and lymph glands. In comparing infectious abortion in swine and cattle, Makojewsky and his colleagues found that in the infectious abortion of swine *brucella suis* is the main agent. For cattle, *brucella suis* is less pathogenic, however, germs may be eliminated with the milk. *Brucella suis* in the body of swine is not localized to the degree of *brucella abortus*, Bangs in cattle. A large percentage of infected swine will recover and will produce healthy litters.

Brucella suis is of great tenacity. According to Lindenstruth, *brucella suis* is very resistant to pickling and freezing, so that the only way of destroying them in food is by boiling or steaming. According to Schlossberger, cases of *brucella suis* in human beings having eaten raw ground pork are described in American literature. Hutchings, Bunell and others have found *brucella suis* in the muscles of slaughter hogs up to 20 days after they were killed.

Brucella suis is considerably more pathogenic both for human beings and for test animals than can be assumed for *br. abortus* Bang.

Many cases of human beings affected are reported in the literature. About 6,000 cases were registered in the US in 1947. Cases have been reported from many other countries as well, e.g. from Italy, South Africa, Switzerland, France, etc. Germany is no exception. Therefore it was made compulsory in Western Germany in 1949 to report brucellosis in swine. Further protective measures were taken in 1950. Disinfection is performed according to paragraph 56 of the AB.A of the meat inspection regulations. It has been proposed to pass the flesh for canning or for sausage making after sufficient heating. Giseke points out that the required temperatures are not reached. In boiling, however, when properly done, the necessary temperatures are usually obtained.

Next to per os infection through eating meat, etc., special attention must be given to infection by contact. As a safeguard, Heidrich proposes the following:

1. Before slaughtering, the personnel must be instructed about brucellosis in swine in general, about the abnormalities to be found during slaughtering and processing, about the possibility of infection from blood or flesh before sterilization by boiling or steaming, and about the importance of personal hygiene while working in order to avoid contact infection.
2. According to recent research in regard to packing house sanitation, swine should be bled while suspended in order to insure quick and thorough bleeding. Precipitated bleeding prevents the distribution of germs as it occurs in the terminal invasion of the blood by bacilli in animals affected by tuberculosis.
3. Rubber gloves should be worn when opening the uterus of swine in order to determine officially the pathological anatomical abnormalities.
4. The cutting of lymph glands by the examining veterinarian should be limited to suspected cases of diseases other than brucellosis.
5. The removal of the easily accessible lymph glands should also be considered, since these are processed together with the muscles, and secondary contamination in the process of cutting up the flesh is not impossible.
6. Spleen and teats of swine are to be condemned. Both are considered inferior for purposes of canning, and they often contain *brucella* as do the lymph glands of the udder.
7. The use of a meat inspector's hook (Meyer 1958) as employed in packing houses at Minden and Herford seems advisable for the protection of the examining veterinarian against injuries.

8. Cleanliness, intermediate cleansing, and intermediate disinfection must be stressed especially. Washing and sterilizing basins and paper towels should be available. Personal hygiene should be observed, especially before eating. As for the selection of suitable disinfectants, the usual ones are supposed to be effective within a relatively short time. In recent tests of disinfectants -- performed with culture solutions of br. bovis with added serum -- 0.2% solutions of Sagrotan, chlorocresol, crude chloramine and Gevisol proved to be effective (Haupt and Wochau 1957).

9. Even small skin lesions must be reported and treated immediately. Sublimate, which has proved effective, should be on hand at all times.

10. Regular hygienic supervision of personnel is mandatory. Serological testing at regular intervals after slaughtering during an epidemic should not prove too difficult, considering the small number of personnel involved. We must remember the necessity of spotting brucellosis infection in human beings as early as possible; early recognition is essential for successful therapy. Even then the disease can be cured only in 20-30% of the cases within the first eight weeks after infection; in chronic brucellosis the chances are even smaller, and when organs have been irreversibly affected, even antibiotics are of doubtful value.

Schonberg and Zietzchmann in Die Ausföhrung der tierarztlichen Fleischuntersuchung [Procedures of Veterinary Meat Inspection] (1951) demand with regard to brucellosis in swine that all affected animals or those found to be infected be "passed with restrictions". The flesh might be suitable for canning.

3. *Brucella abortus* Bang.

Brucella abortus bovis was discovered in 1896 by Bang and Stribolt. Br. abortus Bang is pathogenic mainly for cattle and is the agent causing epidemic abortion in cattle; but germ carriers often do not show any clinical manifestations. *Brucella* germs remain alive in the animal's body and are eliminated with the milk. The disease has spread all over the world and affects many breeds of cattle, also sheep and goats. There have been reports on artificial infections. Br. abortus Bang may also occur in horses.

Considering the wide distribution of cattle, it is evident that human beings are quite often affected by the disease. The close contact of human beings with cattle leads to the conclusion that it is this type of brucella which causes most cases of the disease in man. Naturally, the majority of cases is found among persons engaged in farming, who may be infected by contact or by drinking raw milk. According to recent tabulations by Knothe, Pels-Leusden and Werner, by far the majority of cases of brucellosis in man occur in Schleswig-Holstein and Lower Saxony as compared to the other states of Western Germany.

From 1928-1953 there were 520 registered cases of human beings affected, that is 57% of all diseases caused by drinking infected milk.

Undulant fever has been carried in the statistics of the Bulletin of the National Public Health Department for many years. In 1938, 600 cases were reported, in 1939, 400, and after 1945 about 200-300 cases per year (Knothe, Pels-Leusden). According to Poppe, the number of cases is even higher, as many illnesses are not specifically identified and therefore not reported.

In the affected human being, br. abortus Bang settles first in the lymphatic tissues and from there it is distributed through the ductus thoracicus to the blood and portal circulation, and from there to the places where they multiply, that is, liver and spleen. Latent infections occur also. Diseases of the skin in the form of necrosis and pustules occur as an occupational disease in veterinaries. When the nervous system is affected, the case is more severe. The symptoms are usually very diversified and uncharacteristic. It has been said that the germ has become pathogenic for man because it has passed through so many animals. Infection is percutaneous, or peroral by drinking raw milk.

In infections caused by contact with flesh, Thomsen found that the formation of a blood titer in butchers may be caused by contact with infected genitals or udders rather than with blood or flesh.

Lerche remarked in 1931, with regard to oral infection through meat consumption, that it is possible to become infected from eating raw meat, such as ground meat.

Kruger says that infected flesh is a source of infection only when eaten raw during butchering. Several times, cultures of Bang bacilli were obtained from organs and muscles of artificially infected cattle; Schmidt has examined about 800 head of cattle in Saxony with regard to br. abortus Bang in the flesh and found 2.6% positive reactors in serological tests. It was not possible to determine br. abortus Bang either by culture or by live animal tests.

In serological tests performed in Bavaria, Buehler found that 10% of all cattle were infected.

For the GDR the percentage of infected communities was found to be 49%.

Schaal (1958) determined at this time that before proposing the condemnation of the flesh, a number of large scale investigations must be carried out. Note the fact that e.g. in Northern Germany 14-20% of the total of slaughtered cattle are infected with brucellosis, and that condemnation would have far-reaching effects.

The situation in regard to sanitary inspection of the organs is slightly different, since every organ may be considered to be a main focus of localization and a reservoir. Inspection could plug up an important source of infection, and thus at least the most urgent measures would have been taken until a regulation for the entire problem can be found.

Various researchers have investigated the number of brucella occurring in the udder of slaughter animals affected by brucellosis and have found up to 30,000 brucella per ccm of milk. The number of germs decreased with increasing lactation, when the disease became increasingly

chronic, and with increasing age. The question remained whether the same high count would be present in older slaughter animals where the disease is usually chronic and where milk production has decreased. In the Duisburg packing house, the brucella content of the milk of 80 brucellous slaughter cows was examined before killing. According to the test, the milk seemed wholesome and the conclusion was drawn that according to legal regulations the udder would be passed. Of the 80 positive milk samples, 42% had a titer of 1:20, 29% a titer of 1:40, and 29% a titer of 1:80 or higher. The highest titer was 1:320, i.e., the animal must have been chronically diseased (Table 8). Fully virulent brucella could be bred from 36% of all Bang positive milk samples; all of them were brucella abortus.

The lowest distribution found were scattered colonies, the highest about 10,000 germs per ccm of milk. With increasing titer, the elimination of brucella usually increases as well. The combined total milk production was also examined.

Table 8.
Relation between level of titer and number of brucella eliminated

Quantitative	Scattered	To 50	To 100	To 500	To 1000	To 5000	More
Titer to 1:20	2				1		
" 1:40		2	2		1	3	1
" 1:80				1	1	1	1
" 1:160				3	1	2	1
" 1:320			1	1		2	2

According to Rojahn, only 30% of the animals passing brucella with their milk are infected in three or all four quarters of the udder. 70% pass only from one or two quarters of the udder. For purposes of meat sanitation we must now investigate whether the percentage of germs in the milk is identical with that in the udder tissue. According to Rojahn, Lerche, and Entel the number of germs in the udder tissue corresponds to a large extent to that in the mammary and iliac lymph glands and to the passing of germs with the milk. Since in the course of this disease the brucella germs first settle in the alveoli of the glands and are distributed only from there into the milk, we must conclude that the udder tissue contains a considerably larger amount of brucella than does the milk. From test results reported by Schaal we must conclude that the udder tissue contains millions of germs.

From all these facts Schaal draws the following conclusions:

1. The high content of fully virulent germs in the udder is a danger to packing house personnel. Brucella are capable of entering the human body through the smallest lesions of the skin, possibly even through healthy skin. When cleaning out the carcasses even the most careful worker cannot avoid all contact with the germs.

2. The discharge of milk containing brucella, which is unavoidable during slaughtering, effects a postmortal contamination of the flesh, hide, and butchering tools.

Gland tissue containing brucella is to be passed without restrictions if there are no macroscopically visible abnormalities, in spite of their germ content. Thus parts of flesh invaded by pathogenic germs may be exempted from the necessary meat inspection control measures. There is no guarantee that they are processed and used in a safe and sanitary manner. Because of the high brucella content in the udder tissue, there is a possibility of infection of human beings when not properly sterilized because of insufficient heating or otherwise ineffective disinfectants. This danger of infection also exists for domestic animals if they are fed such flesh.

That brucellosis in slaughter cattle is a potential source of infection for packing house veterinarians is proved by the results of investigations undertaken by Meyn, Schrinner, and Stettwieser (1960). They report on 45 carcasses suspected of being affected by brucellosis on the basis of clinical evidence or serological tests, the flesh and organs of which carcasses had been passed for food. Of these 45 carcasses the following samples were tested:

1. Blood from the slaughter wound
2. Lymph gland of the shoulder clod
3. Iliac lymph gland
4. Intestinal lymph gland
5. Lymph gland of the udder
6. Hepatic lymph gland
7. A piece of liver
8. " " " spleen
9. " muscle from the diaphragm
10. " " " " hind leg.

For testing brucella germs in cultures, samples were singed and from the inside of these, cubes of 2 cm side length were cut in a sterile manner; the cut surface of each cube was rubbed over an agar strip. "Medium W" by Kuzdas and Morse without circulin was used for a culture medium. 5 ml of "Tween 40" per albimiagar were added instead of crystal violet. The inoculated strips were kept in an airtight incubator for 6 to 10 days in an atmosphere of 10% CO₂. The grown colonies were examined as to species by microscope and by agglutination test. Brucella were determined in 13 of the cases, or 29%.

Furthermore, 400 slaughter cattle from the Munich packing house were examined serologically. Of these, 88 (22%) showed a positive agglutination titer of 1:40 and above, 46 (11.5%) a doubtful agglutination titer of 1:20 to 1:40.

Of 40 veterinarians employed at the Munich packing house who did not show any clinical manifestations, 14 (35%) reacted positively to serological agglutination tests for brucellosis. The complement-fixation test had positive results in 4 cases (10%).

On the basis of these tests, the authors conclude that the infection found in some of the veterinarians employed in the packing plant is to be traced to the manner in which the meat inspection is carried out. They believe that brucellous slaughter animals must in all cases be considered a potential source of infection.

Considering this grave danger, it seems mandatory from the point of view of meat sanitation, that the udder of brucellous cows be condemned, including the corresponding lymph glands.

Schaal concludes from test results by Benning that 25% of all brucellous udders contain between 1,000 and 10,000 Bang bacilli per 1 g. of tissue.

He emphasizes that for each slaughter animal infected with Bang bacilli, the presence of a large number of brucella germs in the udder must be assumed. He believes that in this high germ content there lies a great danger for the personnel of packing plants. Furthermore, there is a possibility of postmortal infection. Schaal writes: "Acute danger lies mainly in brucellous udders and in the milk and secretions contained therein. He also indicates the many ways in which contamination may occur during the slaughtering process. He considers the inclusion of brucellosis in the meat inspection regulation as urgent, furthermore he proposes changes in slaughtering and processing methods and the removal of udder and adjacent membrane in toto after bleeding.

Also, he believes that the dangers to health resulting especially from the possibility of a high brucella germ content in the udder must be made clear to personnel working in meat packing and processing plants. Schaal, Benning and Weins, Meyn, Schliesser and Ehrle as well as Lerche and Entel subsequently found live brucella in muscles and organs of animals which had reacted positively. Hiltmann examined 1,801 heads of cattle; 6.2% had a positive blood titer. Since the results of rapid whole blood agglutination tests corresponded to those of the long test in only 54 cases, only these cases were examined further. Even though the blood titers showed high values, brucella could be determined in liver broth-Victoria blue-agar according to Ståfseth only three times in the flesh, seven times in organs and nine times in the lymph glands. The culture medium had been modified by liver broth according to Kelch.

In the udder and corresponding lymph glands brucella germs were found in four cases. In two cases the culture tests were confirmed by live animal tests. Six times brucella germs were found present in organs (spleen, testicle, kidneys) by cultures. In several other cases brucella germs were also found present with a special stain according to the method of Koslowski and Hansen.

Thus, live animal tests did not always correspond to the culture test. This leads to the conclusion that for the determination of brucella in slaughter animals which had reacted positively to serum tests, culture and live animal tests should be carried out as well. A much higher percentage of positive test results was obtained in live animal tests. A whole blood rapid agglutination test with stain for brucellosis and the serological rapid agglutination test did not fulfill expectations. From the literature and tests described, Leistner derives the following conclusions concerning further measures in regard to brucellosis animals:

"We believe that a large percentage of the steadily increasing number of cases in man can be traced to the contact with affected slaughter animals and to the eating of raw infected meat.

We therefore propose that animals affected by brucellosis should be included in the meat inspection regulations, and that a new edition of such regulations should take this fact into consideration.

Positive reactors must be slaughtered in emergency slaughter houses or in official veterinary establishments.

Concerning the disposition of animals affected with brucellosis the following is proposed:

The organs of such animals and all lymph glands are to be condemned. Carcasses of animals which reacted positively to serological tests but showed no pathologic anatomical abnormalities in flesh or organs are to be passed for canning or for sausages which must be boiled, or deep freezing.

The udders of serologically positive animals are to be condemned.

The organs of serologically positive animals without pathologic anatomical abnormalities are to be used for sausages, which have to be cooked or boiled, or for canning.

Furs and hides of all animals affected with brucellosis must not be shipped until they have been salted and stored for two months.

For the protection of human health, the following measures are required and proposed: In slaughtering and processing the flesh of an animal affected with brucellosis, the personnel must observe all safety measures.

In analogy to the test of feces and urine required by health and sanitation authorities for employees in the food industries, serological blood tests for brucellosis should be performed for packing house personnel.

Lerche and Entel have carried out tests with regard to the question of how brucella germs behave in the process of aging of the meat and have published the results. They surmised that a transmission of brucellosis to human beings by eating contaminated meat or products thereof depends on the type of product and on the virulence of the germ. In meat, this means that the germ must be resistant to biochemical processes to make infection possible. The tests by Lerche and Entel showed that the lowering of the pH value of the meat alone does not decrease the virulence of the brucella. In the first few days a considerable decrease in germs was

found in the test animals, parallel to the extensive biochemical changes, which then slowly tapered off. Thus the germ content of the meat does decrease, but not the virulence of the surviving brucella. Attention is further drawn to the fact that for the purposes of food sanitation only a very real danger for the health of human beings can lead to official regulations governing infected food, since it is well known that alimentary transmission of brucellosis does not always lead to disease, and that even in experiments, infection resulted only after large quantities had been given repeatedly to the persons tested. Most frequently, brucella germs were found in the udder, uterus, spleen, liver and the lymph glands of the liver. In the flesh, however, a small number of brucella germs were found only in a few diseased animals, and these decreased further when kept in cold storage and in the aging process, so that danger of infection by the few Bang bacteria pathogenic to man is not to be feared, according to Lerche and Entel. Pickling in a 25% solution of nitrate effected a slow reduction in brucella germs. As the effective temperature rose, the reduction in germs was accelerated. Nitrite brine was a better deterrent than salt.

Heating to 50-62°C was fatal to germs within one minute. Frozen rabbit meat contained virulent brucella germs even after 1 1/2 years of storage at -27°C. No noticeable differences in the behavior of the various types were observed in tests. In raw sausage, however, there was a decrease in virulence ranging from brucella melitensis to suis to abortus.

Table 9.

Life expectancy of brucella germs in raw sausage, by days

Type of brucella	Raw Sausage	
	smoked *)	dried
Abortus	21	35
Suis	14	21
Melitensis	7	14

*) 7 days cold smoking

Entel derives from the tests with regard to infection in man that beside a high germ content in food, the virulence of the germs is a direct prerequisite. Of the three known types of brucella, melitensis, especially, is highly pathogenic for man, while brucella abortus led to infection

sometimes only after repeated intake of large quantities of germs by test persons. On the basis of the above test results, we therefore suggest the following:

1. For the protection of human health against brucellosis infection, the slaughtering of sheep suspected of being infected must be prohibited.

2. The AB.A governing the inspection of cattle infected with brucellosis must be changed to the effect that organs carrying germs, such as udder, spleen and liver, and the lymph glands in the flesh, especially the large inner iliac lymph gland, must be condemned and destroyed in a safe manner.

However, the eating of meat and meat products does not constitute a danger of infection for man because of the low germ content in the muscle flesh, especially since the germ content decreases after slaughtering. Therefore it does not seem necessary to condemn such carcasses. It is very important to avoid postmortal contamination of the meat by the milk eliminated and by contact with organs containing germs when slaughtering brucellous cattle.

Lerche and Entel recommend that in slaughtering, the udder and its membrane be removed in toto from the carcass before skinning the bled carcass.

In the directions for the veterinary sanitation inspection of slaughter animals and the veterinary inspection of meat and meat products of the USSR of 1959, the chapter covering all forms of brucellosis reads as follows:

29. Brucellosis

- a) The carcasses of all kinds of animals showing clinical or pathologic anatomical evidence of brucellosis are to be disinfected according to paragraph 134a).

The flesh of goats which have reacted positively to brucellosis may be used for the production of sausage and canned goods under observation of the requirements laid down in Paragraph 137, or they are to be sterilized according to Paragraph 134a).

Intestines, esophagus and a bladder taken from animals which have reacted positively to brucellosis tests are pickled in a 15% salt brine with the addition of a 0.5% dilution of hydrochloric acid for 48 hours at a temperature of 15-20°C and a liquid coefficient of 1:2. In working with these raw materials work safety regulations must be observed.

Intestines, esophagus and bladder of clinically affected animals are to be destroyed.

The vat containing raw intestines from animals infected with brucellosis must be marked as to the beginning and end of the disinfection period and must bear the signature of the veterinarian supervisor.

- b) The carcasses of cattle and swine which reacted positively to brucellosis tests but did not show clinical or pathologic anatomical abnormalities are passed without restriction. The flesh from sheep is passed for sausage production.

c) The udder of cows, sheep and goats without clinical evidence of brucellosis or pathologic anatomical abnormalities based on brucellosis are sterilized according to Paragraph 134a).

d) Liver, kidneys, heart, lungs, head, esophagus, bristles, ears, cheeks, stomach, diaphragm and other byproducts which reacted to brucellosis tests or showed clinical signs of brucellosis are sterilized according to Paragraph 134a) of these regulations.

e) It is prohibited to take endocrine glands for medical purposes from animals with clinical manifestations of brucellosis. The blood of animals affected by brucellosis or having reacted positively to tests may be used for industrial purposes after sterilization by boiling.

It is permissible to collect the pancreas for the production of crystalline insulin from positive reactors but without clinical and pathologic-anatomical abnormalities caused by brucellosis.

f) Hides obtained in the slaughtering of brucellosis animals of all kinds may be passed only after thorough sterilization.

In slaughtering animals affected by brucellosis, during the processing of the flesh, and during the sterilization of by-products, personnel must observe work safety regulations.

The Regulations Governing the Meat Inspection of the US Department of Agriculture, 1952, Part 11 Sec. 16, read as follows with regard to brucellosis:

Carcasses affected with lesions of brucellosis may be passed for food after the affected parts have been removed.

According to Barnitzki, the life expectancy of brucella germs in the flesh is 27 to 67 days (Kolyakov 1952), and in dry salting (10% salt), the germs are pathogenic up to 30 days (Schur 1959, Tarasov 1937). Agulnik and Teternik (1937) found that brucella abortus stays alive not longer than two months, brucella suis up to 83 days, and brucella melitensis more than two months in salted meat.

These findings have been incorporated into the new Soviet meat inspection regulations. According to the new regulations, the flesh from brucellosis swine is no longer disinfected by pickling, but only by boiling. Only intestines, esophagus and bladder from positive reactors may be pickled, since before being used as casings they are further processed according to certain minimal sanitary requirements.

Barnitzki in her dissertation sees the lack of directions for the disposition of brucellosis animals in the German meat inspection laws as a great defect. According to Barnitzki, economic concessions and the difficulty of determining brucellosis within the time limit allowed for meat inspection have caused the omission of brucellosis from meat inspection regulations by the law makers. The author especially stresses the value of pre-examination during delivery of the livestock, as required in the Soviet regulations.

For the control of brucellosis in the GDR it has been proposed to permanently mark animals which have reacted positively, so that the necessary measures may be taken immediately upon their arrival in the packing plant.

Since Kling and Otero have also called attention to the fact that all three types of brucella germs are pathogenic for human beings, Barnitzki believes that a distinction between the three types when covered in a new version of the meat inspection regulation would be unnecessary.

As is evident from the assertions made in the literature, it is necessary to consider brucellosis in our meat inspection laws. Disposition in the case of brucella melitensis and suis needs no further discussion. Only for br. abortus Bang is more thorough discussion necessary, since this germ is comparatively widespread, while there are relatively few cases of infection in human beings. Possibly a sliding regulation adjustable to the relative stage of success reached in controlling the disease could be effected. The difficulties and the amount of time involved in determining the type, without even considering other problems, clearly indicates the way to a different outlook or a complete change in the inspection of slaughter cattle. But a new basis must be created for the supervision of livestock on the farm, which is a branch of the good industry, and of the slaughter animals raised there.

We believe that some other zoonoses which are not prominent at the present time will create problems in the field of meat sanitation, so that certain partial corrections should be effected in the inspection of slaughter animals, which should extend to the care and supervision of livestock intended for slaughter. However, the topic will not be discussed further here.

In conclusion, we would like to state that the meat inspection regulations as concerns tuberculosis and brucellosis in slaughter animals as they stand today do not meet the requirements generated by the scientific advances in the field of meat sanitation, nor those of preventive medicine. We have proposed changes and we are stressing the fact that meat inspection in the future will become reoriented to go hand in hand with the sanitary care of livestock intended for slaughter in the light of the concept "the agricultural plant is a branch of the food industry", and that the zoonoses will be covered in such inspection.